

REMARKS

In the Office Action mailed on April 8, 2005, claims 1-20 have been rejected as obvious under 35 U.S.C. §103(a) over U.S. Patent No. 5,878,053 to *Koh* et al. (“*Koh*”). All of the independent claims have been amended herein to more clearly reflect various embodiments of the present invention. Because *Koh* fails to disclose or suggest elements required by the claims 1-20 as amended, the obviousness rejection is traversed.

Amended independent claim 1 recites steps, among others, of selecting at least a first net from a plurality of nets contained in a distributed integrated circuit model, with all of the nets being distributed RC models. Claim 1 further requires compressing at least a second net connected to the first net by removing all resistors from the distributed RC model of the second net and assigning the second net a sum total capacitance. As discussed in the specification, the method of claim 1 can be thought of as:

... converting the distributed model ... into a hybrid lumped/distributed model. That is, after the compression steps the power grid nets will remain with capacitors and resistors in a distributed format while secondary nets will have resistors removed and capacitors represented in a lumped format. The IC model is thereby simplified ... without loss of information required for effective analysis for purposes such as electromigration. Many problems of the prior art are therefore solved.

Specification, p. 9, line 27 – p. 10, line 3.

This claimed step of compression by removing resistors and assigning a total capacitance to the second net is one of the important aspects of the present invention that *Koh* fails to disclose or suggest. *Koh* fails to teach the claimed step of compression including removing resistors and “lumping” capacitors, but instead discloses only well-known methods for creating an RC model: “the principles behind the reductions are well known in the art...by iteratively reducing the resistors, inductors, and capacitors a complex circuit can be reduced into simpler circuits that is (sic) electrically equivalent to the original circuit.” *Koh*, col. 5, lines 15-21. *Koh* therefore fails to disclose or suggest removing resistors, but instead teaches using an RC network with an equivalent circuit that *includes* resistors: “Next, stage 102 models the power RC networks of these blocks

with simplified equivalent circuits. The simplified circuits are electrically the same as actual circuits of the blocks they represent, except the total number of components have been reduced.” Id., col. 3, lines 50-54 (underlined emphasis added). *Koh*’s models will therefore be substantially larger and more cumbersome to deal with than those created through the compression steps of claim 1.

Koh also does not teach or suggest the claimed steps of using a first net in a distributed RC model format and compressing at least a second net connected to the first net by removing resistors and summing capacitors. As discussed above, these claimed steps result in what the specification of the present application refers to as a “hybrid lumped/distributed model.” Specification, p. 9, line 27 – p. 10, line 3. Instead, *Koh* teaches using the same steps to model all connected power RC networks. *Koh*, col. 3, lines 50-54. For these reasons, independent claim 1 and claims 2-7 that depend from it are allowable over *Koh*.

Independent claim 8 is directed to a method for performing an electromigration analysis on a distributed integrated circuit. It includes several steps not disclosed or suggested by *Koh*. For example, claim 8 requires (among other steps) selecting a group of first nets that define the power grid from a net list, where each is a distributed RC model. Claim 8 further requires compressing a plurality of secondary nets connected to the power grid by removing resistors from their distributed RC model and assigning a total capacitance value equal to the sum of capacitance of the secondary net. As discussed above, *Koh* fails to disclose these steps, but instead simply teaches using a well known RC model.

Independent claim 9 is directed to a method for performing a gross current estimation on a distributed integrated circuit. Claim 9 requires steps, among others, of selecting a first net to perform the gross current estimation on, the first net having a distributed RC model, and compressing the first net by removing all resistors from the distributed RC model of the first net and summing all capacitors. Independent claim 9 also requires compressing at least a secondary net connected to the first net by removing

all resistors from an RC distributed model of the secondary net and summing all capacitors. As discussed above, *Koh* fails to disclose or suggest these steps.

Claims 8 and 9 also require steps of performing an electromigration analysis and calculating a gross current estimation, respectively. Because *Koh* teaches a more complicated RC model as opposed to the smaller compressed “hybrid lumped/distributed” models that result through practice of the invention embodiments of claims 8 and 9, *Koh* will fail to achieve the benefits of the invention embodiments when performing these steps of performing an electromigration analysis and calculating a gross current estimation.

Claims 10-13 depend from claim 9 and are allowable over *Koh* for the same reasons as are that claim. Several of these claims require additional elements not disclosed by *Koh* and are therefore allowable over the reference for further reasons. For example, claim 12 requires determining whether a calculated gross current estimation for the first net exceeds its current limitations and if so uncompressing the first net by returning the compressed net to a distributed model. Claim 12 further requires performing a gross current estimation after uncompressing the first net on individual segments of the distributed model. *Koh* fails to disclose the claimed step of compressing, much less the claimed step of un-compression for further calculation after a determination that a gross current estimation has been exceeded.

Amended independent claim 14 is directed to a computer program product for compressing a distributed integrated circuit model. Independent claim 14 requires, among other elements, steps of selecting at least a first net that is represented by an RC model from a plurality of nets contained in the distributed model and compressing at least a secondary net connected to the first net for removing all resistors from a distributed RC model and summing all capacitors. As discussed above, *Koh* fails to disclose or suggest these elements, but instead simply teaches the well-known step of creating an RC model of a circuit. Claims 15-16 depend from claim 14 and are allowable for the same reasons as are that claim.

Amended independent claim 17 is directed to a computer program product for performing an electromigration analysis on an integrated circuit power grid. Claim 17 requires, among other elements, that program instructions cause a computer to compress a plurality of secondary nets connected to a plurality of first nets, wherein the compressing requires removing resistors from a distributed RC model of the secondary nets, and assigning a total capacitance value. *Koh* fails to disclose or suggest these steps. Claim 17 further requires the computer to perform an electromigration analysis. *Koh* fails to disclose this step.

Independent claim 18 is directed to a computer program product for performing a gross current estimation on a distributed integrated circuit. Independent claim 18 requires computer executable instructions that cause the computer to perform steps, among others, of selecting a first net having a distributed model, and compressing the first net by removing all resistors and summing all capacitors. Claim 18 further requires compressing at least the secondary net by removing all resistors from a distributed RC model and summing all capacitors. As discussed herein above, *Koh* fails to disclose or suggest these elements. For these and other reasons, claims 18 and 19-20 depending therefrom are allowable over *Koh*.

Claims 19 and 20 are allowable over *Koh* for additional reasons. Claim 19 further requires the executable instructions to cause the computer to uncompress the first net if a calculated gross current estimation exceeds the current limitations for the first net by returning the compressed first net to a distributed model. Claim 19 further requires subsequently performing a gross current estimation on individual segments of the uncompressed first net using the compressed secondary net.

Claim 19 further requires that computer program instructions to determine whether the calculated gross current estimation for the first net exceeds the current limitations for the first net, and if so to uncompress the first net by returning it to a distributed model and to subsequently perform gross current estimation of individual segments of the first net using the compressed second net.

If the calculated gross current estimation for the first net does not exceed the limitation, claim 19 further requires the program instructions to select one of the secondary nets to perform a gross current estimation on and to calculate a gross current estimation on the secondary net using remaining of the secondary nets.

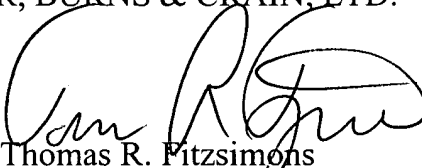
Koh fails to disclose or suggest these required elements. Although in rejecting claim 19 the Office Action suggests that *Koh* discloses “current net analysis including uncompressing power net for gross current estimation in each net”, no supporting citation is provided. It is respectfully submitted that *Koh* fails to make the suggested disclosure. Further, even accepting only for sake of argument that *Koh* can be read to disclose “current net analysis including uncompressing power net for gross current estimation in each net” as the Office Action suggests, it is submitted that the required elements of claim 19 as outlined above require substantially more than this.

In conclusion, it is believed that the obviousness rejection over *Koh* of claims 1-20 is improper and should be withdrawn. All claims in their current form are believed to be allowable. If the Examiner believes that there are additional issues to be addressed before the claims may be allowed, Applicant’s undersigned attorney requests the favor of a phone call to discuss the same.

Respectfully submitted,

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